OPEN ACCESS

KING'S College LONDON

King's Research Portal

DOI:
10.1016/j.tcm.2016.03.003

Document Version
Peer reviewed version

Link to publication record in King's Research Portal

Citation for published version (APA):
Rinaldi, C. A. (2016). The Future Direction of Cardiac Pacing? *TRENDS IN CARDIOVASCULAR MEDICINE*. https://doi.org/10.1016/j.tcm.2016.03.003

Citing this paper
Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

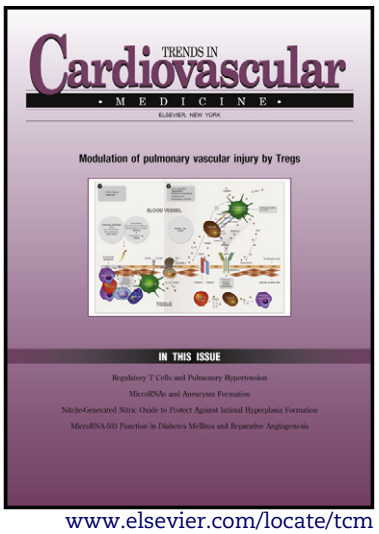
General rights
Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

•Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
•You may not further distribute the material or use it for any profit-making activity or commercial gain
•You may freely distribute the URL identifying the publication in the Research Portal

Take down policy
If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 05. May. 2023

Author's Accepted Manuscript



The Future Direction of Cardiac Pacing?

Christopher Aldo Rinaldi

PII: S1050-1738(16)00069-4
DOI: http://dx.doi.org/10.1016/j.tcm.2016.03.003
Reference: TCM6257

www.elsevier.com/locate/tcm

To appear in: *trends in cardiovascular medicine*

Cite this article as: Christopher Aldo Rinaldi, The Future Direction of Cardiac Pacing?, *trends in cardiovascular medicine,* http://dx.doi.org/10.1016/j.tcm.2016.03.003

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

The future direction of cardiac pacing?

Professor Christopher Aldo Rinaldi

Address

Guy's and St Thomas' Hospitals London and King's College London

St Thomas' Hospital, Westminster Bridge Rd

London UK SE1 7EH

Tel 00442071887188

E mail: c.rinaldi@virgin.net

Disclosures

Professor Rinaldi receives research funding and honoraria from St Jude Medical, Medtronic, Boston Scientific, Spectranetics and Livanova.

Keywords: pacemaker, cardiac resynchronization

Accepted manuscript

The field of cardiac pacemakers and defibrillators has evolved exponentially in the last half century since the initial pacemaker implant was performed in 1958 at the Karolinska Institute in Sweden. The patient receiving the first implantable pacemaker, Arne Larson, went on to have 26 further pacemaker implants during his lifetime and when he died at the age of 86 he had outlived the implanter of the first device. The technology of cardiac implantable devices has changed dramatically and now we are currently entering a brave

ACCEPTED MANUSCRIPT

new world of pacemaker technology with a paradigm shift away from lead based pacemakers with their inherent drawbacks to the so called 'leadless pacemaker' which is now a reality. The current review by Austin and Kusumoto in the current edition of this journal is therefore timely and presents us with a comprehensive update of the current state of the art of cardiac pacing and also future directions for cardiac implantable device technology. (1)

The review covers changes in pacemaker design including the rationale and use of the leadless pacemaker and multisite pacing for cardiac resynchronization. The Achilles heel of cardiac devices has long been the leads which may be prone to failure and that pose a risk if lead extraction is required. The ability to perform cardiac stimulation with leadless pacing is clearly very attractive. Several recently published studies have shown the feasibility of such leadless pacing technologies. (2,3) There are, however, issues relating to the to safety of implantation. The major limitation of the current generation of leadless pacemakers which is pointed out by the authors is that current devices can only deliver single chamber RV pacing. This therefore makes them unsuitable for patients requiring AV synchronous pacing and also cardiac resynchronization therapy. Similarly, defibrillation cannot be delivered via a leadless device. Rather than seeing this as a major limitation making them suitable only for a relatively small number of patients requiring pacing, we should view this as the first step in the development of this technology. What will be required in the next years will be the development of devices that can sense and pace the atrium, possibly with the delivery of multiple devices, to allow AV sequential pacing. The ability to deliver CRT from these devices by placement within the left rather than the right ventricle may also be feasible in the future. The review covers the use of left ventricular endocardial pacing by leadless systems

Accepted manuscript

ACCEPTED MANUSCRIPT

and there is a device now available that can deliver LV endocardial pacing although it does require the presence of an existing trans-venous device to allow delivery of this form of resynchronization. (4) This area of leadless CRT will be of major interest in the coming years although there will be several hurdles that will have to be overcome. Firstly, demonstration of safety in the long and short term including implantation and also the risk of embolic events when these devices are used in the systemic circulation. It is likely that guidance to the optimal site will also be required to achieve the optimal effect as the optimal site of LV endocardial pacing varies between individual patients. Finally, the issue of extraction of these devices when they have been implanted chronically may represent a major issue.

The use of multisite pacing delivered either through multiple leads or multipolar leads is covered. The hypothesis that multisite pacing with the ability to depolarize a larger bulk of myocardium more rapidly and improve CRT response is an attractive one. Several small predominantly single center studies have shown a benefit on acute and short term measures of CRT response with multisite pacing. (5) We should, however, be guarded as these results need to be validated with hard clinical endpoint in a multi-center randomized trials. The currently recruiting MORE CRT MPP study may afford us some answers to the use of multisite pacing and will study approximately 1800 patients looking at the effect of multisite pacing in non responders to standard CRT. (6) Importantly, there are potential pitfalls to the use of multisite pacing with the issue of potentially complicated programming options, potential risk of arrhythmia and, perhaps most importantly, the potential for reduced battery longevity. In view of these factors, it may be that multisite pacing may not be a panacea for all CRT patients but should be used in specific patient populations where

Accepted manuscript

ACCEPTED MANUSCRIPT

response is reduced such as ischemic patients with lesser degrees of QRS prolongation where the benefits are not outweighed by the detrimental effects.

The authors also cover the area of device based diagnosis and treatment of atrial arrhythmias. This is clearly an important topic and the identification of AF at an early stage may also impact treatments such as anticoagulation, which may reduce stroke risk. They also touch on the area of biological pacing with the use of cellular and gene therapies. As the authors rightly point out, this is still in an embryonic stage but remains an exciting area for future study.

As the current review points out, there are many areas of innovation in the field of cardiac pacing that offer great promise for the future. Some of these are further advanced than others. It is clearly a very exciting time in this field and one which is changing rapidly.

Accepted manuscript

ACCEPTED MANUSCRIPT

References

1. Austin C and Kusumoto F. Innovative Pacing: Recent Advances, Emerging Technologies and Future Directions in Cardiac Pacing by Austin and Kusumoto. Trends in Cardiovascular Medicine. In Press 2016
2. Reddy VY, Exner D V, Cantillon DJ, et al. Percutaneous Implantation of an Entirely Intracardiac Leadless Pacemaker. *N Engl J Med*. 2015;373(12):1125-1135.
3. Reynolds D, Duray GZ, Omar R et al. A Leadless Intracardiac transcatheter pacing system. *N Engl J Med*. 2016;374(6):533-541. doi:10.1056/NEJMoa1507192.
4. Auricchio A, Delnoy P-P, Butter C, et al. Feasibility, safety, and short-term outcome of leadless ultrasound- based endocardial left ventricular resynchronization in heart failure patients: results of the wireless stimulation endocardially for CRT (WiSE-CRT) study. *Europace*. 2014;16(5):681-688.
5. Rinaldi CA, Burri H, Thibault B, et al. A review of multisite pacing to achieve cardiac resynchronization therapy. *Europace*. 2015;17(1):7-17
6. More Response on Cardiac Resynchronization Therapy with Multipoint Pacing (MORE CRT-MPP) Clinical Trials.gov identifier NCT02006069

Accepted manuscript